Delivering a Flexible, Future-Proof Avionics Test System

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The cost of failure in the military and commercial avionics industry is extremely high: replacing failed components can be very expensive and some failures can be catastrophic, leading to the ultimate price being paid – the loss of life. Therefore, the electronic systems and sub-assemblies used in these applications are required to meet exceptionally high-quality standards. The very diverse nature of equipment requiring testing in avionic systems has traditionally called for an equally complex range of test equipment required to measure signals ranging from DC to microwave. A major multinational avionics manufacturer recently engaged with Pickering to architect a core switching subsystem for a scalable avionics functional test system to be used across a variety of its platforms and projects. The development of such a flexible core test system is intended to reduce ongoing engineering costs and the time associated with test system development. Leveraging as much of the engineering effort invested in the new core switching system as possible offers time and cost savings on any future project requiring automated test. The company manufactures a diverse range of products and therefore requires a switching system that is capable of addressing an equally diverse range of signal levels and frequencies.

The main challenges presented by the new core system were to cover all existing test requirements as efficiently (cost and footprint) as possible and to have a final design that can address any future or unknown requirements. A scalable, modular switch system was central to the final design allowing additional capability to be added as required. The initial concepts were based on the VXI platform, as the customer had previously worked with VXI-based equipment and also did not think that PXI would provide the switching density required. However, after further consultation, it was concluded that the Pickering PXI switching and simulation product range not only met their requirements but would provide a more scalable solution with a lower risk of obsolescence.

PXI's main advantages: availability and lower cost

The VXIbus has served industry well, but it is more than 30 years old now, and in many cases it is time to move to the more modern PXI platform which is now supported by nearly 70 companies working under the umbrella of the PXI Systems Alliance (PXISA).

PXI's biggest advantage over VXI is product availability. In the nearly 30 years since VXI was introduced, the Consortium that manages the specification has gone from over 40 companies down to just eleven

members, and a large number of the products that were available in VXI in the past are now obsolete. In some specialized applications like data acquisition, there are VXI vendors producing new products. But otherwise, VXI is not recommended for new designs. Aside from some very specialized instrumentation, whatever you can buy in VXI, you can also buy in PXI. In some applications, such as fault insertion during simulation, there are no VXI modules available. Also, because PXI is based on the CompactPCI specification, you can use CompactPCI boards in a PXI system. The trend is clear. There are fewer new VXI modules being developed than new PXI modules, and that will continue as more designers specify PXI over VXI.

A second reason to select the PXI platform is that hardware costs are lower than VXI. Because PXI is based on the PCI bus which is used in many personal computers, it can take advantage of the advances being made to serve that market. As many of the components used in PXI modules are also used for PCI modules, they cost less because so many more of them are made. Therefore, PXI systems typically cost 30-50% less than an equivalent VXI system.

Other advantages that PXI enjoys over VXI include:

- **Faster data transfer.** Standard PXI can transfer data that is 8, 16, 32, or 64 bits wide. VXI can only transfer data that's 8, 16, or 32 bits wide.
- **Greater data throughput.** Because PXIe (Express version of PXI) systems can transfer data over high speed serial busses, the maximum throughput for PXI systems is higher than that for VXI systems. The maximum throughput for VXI systems is only 160 Mbytes/s, while the maximum throughput for PXIe systems is 12 Gbytes/s.
- **Small size.** PXI systems have the smallest footprint of any open-architecture instrumentation system, enabling test system developers to cram more functionality into their test systems.

Migrating from VXI to PXI

While the availability of PXI switching and instrumentation modules makes the choices relatively easy, there is the issue of migrating test programs from VXI to PXI, specifically in switching applications. The ability to replicate original test configurations to support legacy FRUs (Field Replaceable Units) is important to continue supporting older test programs while planning for future requirements.

To help ease this transition, Pickering has developed PXI switching and simulation modules that closely match the operation of VXI switching modules from major manufacturers. And the company's policy of supporting its PXI switching products for 15-20 years, or even longer, means that a company's next-

generation test systems have a long life. A cross-reference to other manufacturer's VXI switching products is available here.

Other migration issues include the probable need for new cables or adaptors and possible increased cooling demands. Software is another concern. There is no easy way to migrate test programs. But, given the number of good test-development software packages available for the PC platform, this may not be as big an obstacle as it might appear.

The avionics system

For the avionics customer, Pickering configured a system based on a number of the company's PXI switching modules including: 16x SPDT power relay switch modules; 12x SPDT 16A power EMR switch modules; 32x8 high-density, single-slot 3U 2-pole switch matrix modules; 64x4 high-density, single-slot 3U 2-pole switch matrix modules; dual microwave transfer switch modules; and 6GHz triple subminiature SP6T microwave multiplexer modules. In addition to signal switching, 6-channel high-density PXI precision resistor modules were employed to simulate various loading conditions during test, and diagnostics were provided using Pickering's eBIRST switching system test tools.

The new switching system allowed the customer to extend its instrumentation I/O, delivering a comprehensive range of test scenarios and the ability to test a wide range of avionics LRUs (line replaceable units) across different aircraft platforms.

Finally, the support of these switching systems once installed was also a key consideration as the customer could not afford to have extended test system downtime during any fault diagnosis and repair cycle. Here, Pickering's eBIRST switching system test tools were viewed as a valuable resource to identify faults in the field quickly. These tools allow the customer to return products for repair with meaningful diagnostics data, as well as having the option to do on-site repairs without voiding the warranty.

The avionics customer commented that Pickering's key advantage was its core competency and focus on high-density signal switching and the availability of key products, including power, microwave, and signal switching in discrete, multiplexer and matrix topologies.